Polycyclic Aromatic Hydrocarbons

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Polycyclic aromatic hydrocarbons (PAHs) include hundreds of different chemicals that commonly occur as mixtures in the environment. Limited toxicological data are available on PAH mixtures; therefore, individual PAHs are typically evaluated as separate chemicals for risk characterization. Analyses of samples from sites where PAHs are a concern should include the carcinogenic (cPAH) and non-carcinogenic PAHs listed below.

Carcinogenic PAHs

Benz[a]anthracene	Dibenzo[a,l]pyrene
Benzo[b]fluoranthene	7,12 Dimethylbenz-anthracene
Benzo[j]fluoranthene	1,6-Dinitropyrene
Benzo[k]fluoranthene	1,8-Dinitropyrene
Benzo[a]pyrene	Indeno[1,2,3,-c,d]pyrene
Chrysene	3-Methylcholanthrene
Dibenz[a,j]acridine	5-Methylchrysene
Dibenz[a,h]acridine	5-Nitroacenaphthene
Dibenz(a,h)anthracene	1-Nitropyrene
7H-Dibenzo[c,g]carbazole	4-Nitropyrene
Dibenzo[a,e]pyrene	6-Nitrochrysene
Dibenzo[a,h]pyrene	2-Nitrofluorene
Dibenzo[a,i]pyrene	Quinoline *

**Carcinogenic PAH with an SRV but not included in the BaP equivalents calculation.*

Noncarcinogenic PAHs

Acenaphthene	Fluorene
Acenaphthylene	2-Methylnaphthalene
Anthracene	Naphthalene
Benzo(g,h,i)perylene	Phenanthrene
Fluoranthene	Pvrene

The Minnesota Department Health (MDH) recommends that the 25 cPAHs identified by the California Environmental Protection Agency be evaluated as probable or possible carcinogens at this time. The rationale for this expanded list of PAHs and advice on how to assess risk is contained in the MDH memo sent to Minnesota Pollution Control Agency (MPCA) in 2002 available at www.health.state.mn.us/divs/eh/risk/guidance/pahmemo.html.

Minnesota uses Potency Equivalency Factors (PEFs) to evaluate toxicity and to assess risks of cPAHs. A PEF is a relative estimate of toxicity of chemical compared to a reference chemical. Benzo(a)pyrene (BaP) was chosen as a reference chemical for cPAHs because its toxicity is well characterized.

The table used to calculate BaP equivalents is found in on the Soil Reference Value (SRV) spreadsheet at www.pca.state.mn.us/publications/risk-tier2srv.xls and the Drinking Water Criteria spreadsheet at www.pca.state.mn.us/publications/risk-drinkingwatercriteria.xls on the MPCA Web site. The existing SRVs and the Health Based Value for ground water for BaP equivalents are listed on these Web pages.

General guidance on data collection and evaluation can be found in the MPCA's Risk-Based Guidance for the Soil-Human Health Pathway at www.pca.state.mn.us/cleanup/pubs/srv3_99.pdf.

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Laboratories that have obtained certification from the MDH to perform the PAH analysis are identified at the MDH's Certification Program Web site (http://www.health.state.mn.us/divs/phl/cert).

In calculating the BaP equivalents, there are three ways of handling non-detects (ND). The first way is to substitute the concentration of the individual report level for the ND. This is the most conservative approach. The second way is to substitute one-half the report level for the ND. The assumption is that there is a continuous, evenly-distributed data set of values between zero and the report level. The third way is to substitute zero for the ND. This is the most liberal approach. The consultant should calculate the BaP equivalents all three ways and submit the results to the MPCA project staff for evaluation and instructions.